**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Application No.:	10/693,820	§	Examiner:	S. Y. Paik
Confirmation No.:	1426	§	Art Unit:	3742
Filing Date:	October 24, 2003	§	Atty. Dkt. No.:	5659-20900/EBM
Inventors:	Sandberg et al.	§		
Title:	HIGH VOLTAGE TEMPERATURE LIMITED HEATERS	§		

CERTIFICATE OF ELECTRONIC TRANSMISSION
UNDER 37 C.F.R. §1.8

DATE OF DEPOSIT: 3/9/09

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Jackie L. Pitre

APPEAL BRIEF

Mail Stop Appeal Brief-Patents
Commissioner for Patents
P.O. Box 1450
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Sir:

Further to the Notice of Appeal filed on December 8, 2008, Appellant presents this Appeal Brief. Appellants respectfully request that the Board of Patent Appeals and Interferences consider this appeal.

I. REAL PARTY IN INTEREST

As evidenced by the assignment recorded at Reel/Frame 015211/0695, the subject application is owned by Shell Oil Company, a corporation organized and existing under and by the virtue of the laws of the state of Delaware.

II. RELATED APPEALS AND INTERFERENCES

Appeals that may directly affect or be directly affected by or have a bearing on the Board's decision in this appeal are pending in U.S. Pat. Appl. No. 10/693,816; U.S. Pat. Appl. No. 10/693,700; U.S. Pat. Appl. No. 10/693,840; and U.S. Pat. Appl. No. 11/112,881.

III. STATUS OF CLAIMS

Claims 1-1690, 1697, 1717, and 1735 and are canceled in the present application. Claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753 are pending in the present application. Claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753 stand finally rejected under U.S.C. 103(a). Claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753 stand provisionally rejected on the ground of nonstatutory obviousness-type double patenting. A copy of claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753, as on appeal (incorporating all amendments), is included in the Claims Appendix hereto. Claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753 are the subject of this appeal.

IV. Status of Amendments

All amendments filed by Appellant have been entered and are reflected in the current state of the claims. The Appendix hereto reflects the current state of the claims.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 1691 is directed to a system configured to heat a hydrocarbon containing formation. The system includes a heater well (640) extending from a surface (840) of the earth through an overburden (560) of the formation and into a hydrocarbon containing layer (556) in the formation (see, for example, FIGS. 89 and 90 and Specification, page 39, lines 4-15; page 53, lines 12-17; page 67, lines 1-8; and page 188, line 1 to page 189, line 24). An alternating current ("AC") supply is configured to provide AC at a voltage above about 200 volts (see, for example, Specification, page 20, lines 4-13 and page 169, lines 18-20). One or more electrical conductors (822) are located in the heater well (640) and extend from the surface (840) into the hydrocarbon containing layer (556) (see, for example, FIGS. 89 and 90 and Specification, page 188, line 1 to page 189, line 24). The electrical conductors are electrically coupled to the AC supply (see, for example, Specification page 20, lines 4-13). At least one electrical conductor (822) includes one or more ferromagnetic sections (786, 812) and is configured to provide an electrically resistive heat output during application of AC to the electrical conductor (822) such that heat transfers from the electrical conductor (822) to hydrocarbons in the hydrocarbon containing layer (556) to at least mobilize some hydrocarbons in the layer (556) (see, for example, FIGS. 64-73 and 97 and Specification: page 20, lines 4-13; page 160, lines 20-26; page 180, line 1 to page 181, line 25; page 195, line 25 to page 196, line 14; and page 212, lines 8-21). One or more of the ferromagnetic sections (786, 812) provide a reduced amount of heat above or near a selected temperature during use (see, for example, Specification, page 20, lines 4-13 and page 157, lines 5 to page 158, line 3). The selected temperature is at or about the Curie temperature of the ferromagnetic section (786, 812) (see, for example, Specification, page 20, lines 4-13 and page 157, lines 5 to page 158, line 3).

Independent claim 1711 is directed to a system configured to heat a hydrocarbon containing formation. The system includes a heater well (640) extending from a surface (840) of the earth through an overburden (560) of the formation and into a hydrocarbon containing layer (556) in the formation (see, for example, FIGS. 89 and 90 and Specification, page 39, lines 4-15; page 53, lines 12-17; page 67, lines 1-8; and page 188, line 1 to page 189, line 24). An AC

supply is configured to provide AC at a voltage above about 200 volts (see, for example, Specification, page 20, lines 15-25 and page 169, lines 18-20). One or more electrical conductors (822) are located in the heater well (640) and extend from the surface (840) into the hydrocarbon containing layer (556) (see, for example, FIGS. 89 and 90 and Specification, page 188, line 1 to page 189, line 24). The electrical conductors are electrically coupled to the AC supply (see, for example, Specification, page 20, lines 15-25). At least one electrical conductor (822) includes one or more ferromagnetic sections (786, 812) and is configured to provide an electrically resistive heat output during application of AC to the electrical conductor (822) such that heat transfers from the electrical conductor (822) to hydrocarbons in the hydrocarbon containing layer (556) to at least mobilize some hydrocarbons in the layer (556) (see, for example, FIGS. 64-73 and 97 and Specification: page 20, lines 15-25; page 160, lines 20-26; page 180, line 1 to page 181, line 25; page 195, line 25 to page 196, line 14; and page 212, lines 8-21). One or more of the ferromagnetic sections (786, 812) provide a reduced amount of heat above or near a selected temperature that is about 20% or less of the heat output at about 50 °C below the selected temperature during use (see, for example, Specification, page 20, lines 15-25; page 157, lines 5 to page 158, line 3; and page 168, lines 3-7). The selected temperature is at or about the Curie temperature of the ferromagnetic section (786, 812) (see, for example, Specification, page 20, lines 15-25 and page 157, lines 5 to page 158, line 3).

Independent claim 1731 is directed to a method of heating a hydrocarbon containing formation. The method includes providing AC at a voltage above about 200 volts to one or more electrical conductors (822) located in a heater well (640) extending from a surface (840) of the earth through an overburden (560) of the formation and into a hydrocarbon containing layer (556) in the formation (see, for example, FIGS. 89 and 90 and Specification, page 20, lines 4-13; page 39, lines 4-15; page 53, lines 12-17; page 67, lines 1-8; page 169, lines 18-20; and page 188, line 1 to page 189, line 24). Providing the AC produces an electrically resistive heat output from the electrical conductors (822) (see, for example, Specification page 20, lines 4-13). At least one of the electrical conductors (822) includes one or more ferromagnetic sections (786, 812) that are configured to provide a reduced amount of heat above or near a selected temperature during use (see, for example, FIGS. 64-73 and 97 and Specification page 20, lines 4-13; page 180, line 1 to

page 181, line 25; and page 195, line 25 to page 196, line 14). The selected temperature is at or about the Curie temperature of the ferromagnetic section (786, 812) (see, for example, Specification page 20, lines 4-13 and page 157, lines 5 to page 158, line 3). Heat is allowed to transfer from the electrical conductors (822) to hydrocarbons in the hydrocarbon containing layer (556) to at least mobilize some hydrocarbons in the layer (556) (see, for example, Specification page 160, lines 20-26 and page 212, lines 8-21).

VI. GROUNDS OF REJECTION

1. Claims 1691-1697, 1699-1717, and 1719-1753 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 4,716,960 to Eastlund et al. (hereinafter "Eastlund") in view of U.S. Patent No. 5,065,818 to Van Egmond (hereinafter "Van Egmond") or U.S. Patent No. 4,382,469 to Bell et al. (hereinafter "Bell"), and European Patent Application 0130671 to Rose (hereinafter "Rose").

2. Claims 1698 and 1718 stand finally rejected under 35 U.S.C. 103(a) as being unpatentable over Eastlund in view of Van Egmond, Bell, and Rose as applied to claims 1691-1697, 1699-1717 and 1719-1753 above, and further in view of Canadian Patent No. 2,151,521 to Bridges et al.

3. Claims 1691-1753 stand as provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1691-1749 of copending U.S. Pat. Appl. No. 10/693,700 or claims 1691-1759 of copending U.S. Pat. Appl. No. 10/693,840.

VII. ARGUMENT

First Ground of Rejection

The Examiner rejected claims 1691-1696, 1699-1716, 1719-1734 and 1736-1753 under 35 U.S.C. 103(a) as being unpatentable over Eastlund in view of Van Egmond or Bell, and Rose. Appellant respectfully traverses these rejections in light of the following remarks. Different groups of claims are addressed under their respective subheadings.

Claims 1691, 1711, and 1731

Claim 1691 describe combinations of features including, but not limited to, the features of:

> a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation; ...
>
> at least one electrical conductor comprising one or more ferromagnetic sections, and being configured to provide an electrically resistive heat output during application of AC to the electrical conductor such that heat transfers from the electrical conductor to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

Claim 1711 describe combinations of features including, but not limited to, the features of:

> a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation; ...
>
> at least one electrical conductor comprising one or more ferromagnetic sections, and being configured to provide an electrically resistive heat output during application of AC to the electrical conductor such that heat transfers from the electrical conductor to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

Claim 1731 describes a combination of features including, but not limited to, the features of:

> providing AC at a voltage above about 200 volts to one or more electrical conductors located in a heater well extending from a surface of the earth through

an overburden of the formation and into a hydrocarbon containing layer in the formation, ...

allowing heat to transfer from the electrical conductors to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

To reject a claim as obvious, the Examiner has the burden of establishing a *prima facie* case of obviousness. *In re Warner et al.*, 379 F.2d 1011, 154 U.S.P.Q. 173, 177-178 (C.C.P.A. 1967). To establish *prima facie* obviousness of a claimed invention, all the claim limitations must be taught or suggested by the prior art. *In re Royka*, 490 F.2d 981, 180 U.S.P.Q. 580 (C.C.P.A. 1974), MPEP § 2143.03.

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." *In re Kotzab*, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000). *In re Lee*, 277 F.3d 1338, 1342-44, 61 USPQ2d 1430, 1433-34 (Fed. Cir. 2002). *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992), MPEP § 2143.01.

A statement that modifications of the prior art to meet the claimed invention would have been "well within the ordinary skill of the art at the time the claimed invention was made" because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. *Ex parte Levengood*, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993). *In re Kotzab* 217 F.3d 1365, 1371, 55 USPQ2d 1313, 1318 (Fed. Cir. 2000).

Whether or not "a particular combination might be 'obvious to try' is not a legitimate test of patentability." *Id.* at 1599, citing *In re Geiqer*, 815 F.2d 868, 688, 2 USPQ2d 1276, 1278 (Fed. Cir. 1987) and *In re Goodwin*, 576 F.2d 375, 377, 198 USPQ 871, 881 (CCPA 1981).

Consequently, it is not permissible for the Examiner to "use hindsight reconstruction to pick and chose among isolated disclosures in the prior art to deprecate the claimed invention." Id. at 1600.

An obvious rejection based upon a modification of a reference that destroys the intent, purpose or function of the invention disclosed in the reference, is not proper and the case of obviousness cannot be properly made. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984).

Appellant's claims describe combinations of features including, but not limited to, using heaters with ferromagnetic material (temperature limited or Curie heaters) to mobilize hydrocarbons in the hydrocarbon containing layer of the formation by heating to high temperatures. None of the cited art teaches or suggests this combination of features. None of the cited art teaches any need for, or benefit from, using this combination of features.

The Claims Are Patentable Over Eastlund

In the Final Office Action, the Examiner states that:

> It is noted that Eastlund shows a heater well, which includes a heater therein, extends into a formation wherein the heater provides a heat for heating hydrocarbons deposited in the heater well, but as indicated in the ground of rejection, Eastlund does not explicitly show an overburden formation. For such overburden formation, the Van Egmond and Bell references are alternatively applied. Van Egmond shows an overburden formation formed near the surface wherein a heater well, including a heater, extends there through for heating the hydrocarbon containing zone. Bell also shows the overburden formation through which a heater is provided. In view of such known formation with the overburden formation that is formed near the surface, the heater well in Eastlund would have extended through the overburden formation for heating the hydrocarbon containing layer.
>
> The applicant argues that in Eastlund teaches for heating the fluids containing the hydrocarbon and not the hydrocarbon containing layer itself, and further argues Eastlund does not provide heat to the lower portion of the well that are closer to the hydrocarbon containing layer. It is noted the hydrocarbon containing layer is a broad recitation which includes any layer that includes hydrocarbon. A fluid layer that contains hydrocarbon would meet the recited hydrocarbon containing layer. Furthermore, there is no other recitation that would distinguish the recited layer from that of Eastlund. Also, as shown by Van Egmond, it is known that a heater

would extend into a hydrocarbon containing zone layer for heating the hydrocarbon.
("Response to Arguments" (Section 6), pages 6-7).

Appellant first notes that the claims recite "a hydrocarbon containing layer **in the formation**" (emphasis added). Thus, Appellant respectfully submits that the Examiner is incorrect when he asserts that "a fluid layer that contains hydrocarbon" is the same as "a hydrocarbon containing layer in the formation." Apparently, the Examiner is asserting that Eastlund's wellbore, which contains hydrocarbons flowing therein, is "a fluid layer that contains hydrocarbons.' This assertion is quite inconsistent with Appellant's specification, which clearly (and correctly) states that underground formations have different layers in them, and some of these layers do/do not contain hydrocarbons. For example, Appellant's specification states:

> A "formation" includes one or more hydrocarbon containing layers, one or more non-hydrocarbon layers, an overburden, and/or an underburden. An "overburden" and/or an "underburden" includes one or more different types of impermeable materials. For example, overburden and/or underburden may include rock, shale, mudstone, or wet/tight carbonate (i.e., an impermeable carbonate without hydrocarbons).
> (Specification, Page 39, lines 4-8)

Second, Eastlund only teaches the heating of fluids that have **<u>already</u>** been mobilized and have moved into the well tubing through perforations 12 (Figure 1) or perforations 113 (Figure 7A). Appellant's claims, however, include heating "such that heat transfers from the electrical conductor to hydrocarbons **in the hydrocarbon containing layer** to at least **mobilize** some hydrocarbons in the layer", in combination with the other features of the claims.

In sum, Eastlund heats hydrocarbons in a well tubing that have **<u>already</u>** mobilized, whereas the claims are directed to a combination of features wherein the heating mobilizes hydrocarbons **<u>before</u>** they enter the well tubing when the hydrocarbons are in the hydrocarbon containing layer.

Third, in Eastlund no portion of the heaters are even proximate to a hydrocarbon containing layer, and thus, Eastlund's system does not transfer heat to hydrocarbons **in** the

hydrocarbon containing layer to mobilize some of such hydrocarbons. The Board's attention is directed to Figures 1 and 7A in Eastlund. In these figures, the bottom of the heater (shown by contactors 18 in FIG. 1 and sinker bar 115 in FIG. 7A) is shown to be **distantly separated** from the perforations 12 in FIG. 1 and perforations 113 in FIG. 7A in view of the "long break lines" (long, ruled thin lines with zigzags) shown in FIG. 1 and FIG. 7A. Long, ruled thin lines with zigzags are an American Society of Mechanical Engineers standard for **long breaks** in technical drawings to delineate where an object is broken to save drawing space (freehand thick lines are used to delineate short breaks).

The distant separation of the heaters from the hydrocarbon containing layers in Eastlund is understandable in view of the fact that the Eastlund was only trying to heat fluids **in upper portions of the well**, as opposed the hydrocarbon containing layer itself. Eastlund states that: "Normally, more heat is needed at the **upper** level of a well." (Eastlund, column 9, lines 62-63). More heat is needed in the upper level of the well because fluids cool as they rise inside the well to the surface (the lower portion of a well is generally hotter than the upper portion of a well since the earth's temperature increases as depth increases). Thus, Eastlund does not provide heat to the lower portions of the well that are closer to the hydrocarbon containing layer, where solids formation are less likely to occur (since the lower portions of the well are deeper and hence hotter). In fact, Eastlund makes the electrical connection for the bottom of the heater "[A]t a selected depth which would be below the normal level of solids formation in the tubing" (Eastlund, column 3, lines 40-41).

Stated another way, in Eastlund, the fluids in the hydrocarbon containing layer are indicated as being already mobilized since Eastlund indicates that such fluids flow through the perforations and into the wellbore. Such fluids are not heated until they have travelled a sufficient distance in the wellbore such that they are cooled or begin to solidify (which will occur at upper levels of the wellbore closer to the earth's surface). This distance is enough that Eastlund specifically indicated that the heating is **distantly** separate from the perforations (this distant separation is shown with multiple long break lines in each of FIG. 1 and FIG 7A of Eastlund). Thus, Eastlund does not provide any teaching, suggestion, or motivation for providing or transferring heat to a hydrocarbon containing layer of the formation and using that heat to

mobilize hydrocarbons in the hydrocarbon containing layer.

The Claims Are Patentable Over Eastlund In View Of Van Egmond

In the Final Office Action, the Examiner states that:

> The applicant argues that Van Egmond discloses a contrary teaching as that of Eastlund by stating that the power supply cables in Van Egmond generates heat at a lower rate and only an insignificant amount of heat while supplying all of the current to the heated zone. This is not a contrary teaching but that is well known in the art of operating a heating element. One of ordinary skill in the art would not want to generate heat in the power supply cable but to the heating element where much heat is generated and is desired. The purpose of the power supply cable is to heat and not to generate heat. This (sic), Van Egmond is not shown to disclose a contrary teaching as that of Eastlund.

("Response to Arguments" (Section 6), pages 7-8.)

Van Egmond provides little or no heating in the overburden and upper portions of the formation, while Eastlund teaches heating in the upper portions of the wellbore (see above arguments and citations from Eastlund). For example, Van Egmond, in contrast to Eastlund, states:

> FIG. 1 shows a well, 1, which extends through a layer of "**overburden**" and zones 1 and 2 of an earth formation. **Zone 2 is a zone which is to be heated**.
> (Van Egmond, column 3, lines 32-34, emphasis added).

> At the interface of the zone **which is to be heated, zone 2**, and the **zone which is not to be heated, zone 1**, power supply cables, 1 and 2, are spliced to heater cables, 9 and 10, through splices, 11 and 12. The heating cables extend downward to the bottom of the zone to be heated.
> (Van Egmond, column 3, lines 43-48, emphasis added).

> The uphole ends of the sheathed heating element cables are preferably connected to power supply cables. Power supply cables are heat-stable similarly insulated and sheathed cables containing cores having ratios of cross-sectional area to resistance making them capable of transmitting the electrical current flowing through the heating elements **while generating heat at a significantly lower rate**. The power supply cables are metal sheathed, mineral insulated, and copper cored, and have cross-sectional areas large enough **to generate only an insignificant amount of heat while supplying all of the current needed to generate the selected temperature in the heated zone.**

(Van Egmond, column 3, lines 4-16, emphasis added)

There is no suggestion in the references themselves or to one of ordinary skill in the art to combine the teachings of Eastlund and Van Egmond. It is unclear to Appellant how one of ordinary skill in the art might be motivated to combine Eastlund with Van Egmond. Eastlund teaches heating in the upper portions (clearly distant from the hydrocarbon layer) or overburden of the formation with **no** heating in the hydrocarbon containing layer of the formation. In contrast, Van Egmond teaches the opposite (i.e., limiting heat output in the overburden of the formation when heating the heated zone (the hydrocarbon containing layer)). In fact, as reasoned above, Van Egmond appears to destroy the intent, purpose, and/or function of the Eastlund invention. It is improper to use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate Appellant's claimed invention without some teaching, suggestion, motivation, or objective reason to combine the teachings of the disclosures.

Moreover, Van Egmond does not teach or suggest any use of temperature limited or Curie heaters, in combination with the features of Appellant's claims.

<u>The Claims Are Patentable Over Eastlund In View of Van Egmond And/Or Bell.</u>

In the Final Office Action, the Examiner states that:

> With respect to Bell, it is noted that Bell is applied to show the heater extends through an overburden formation, and Bell which shows a DC supply rather than the AC supply does not show a contrary teaching over Eastlund since the overall objective remains the same which is to provide an adequate heating to the underground formation containing carbon or hydrocarbon.

("Response to Arguments" (Section 6), page 8).

There is no motivation or objective reason to combine the teachings of Bell with Eastlund and/or Van Egmond. Bell appears to teach applying direct current to the formation through electrodes and producing gas electrochemically in the formation. Bell states:

> This invention relates to in situ production of gas from an underground formation of carbonaceous material and in particular to a process in which gas production is achieved by applying a direct electric current to the formation.

(Bell, column 1, lines 5-9)

> The method involves providing an aqueous electrolyte in contact with the carbonaceous material placing at least two electrically conductive elements, constituting an anode and a cathode, in contact with the electrolyte, and passing a controlled amount of electric current from a direct current source through the formation between the electrically conductive elements at a voltage of at least 0.3 volts, thereby producing gas by electro-chemical action within the formation and the accompanying gasification of said carbonaceous material.
> (Bell, column 2, lines 60 to column 3, line 2)
>
> A current path, represented in the drawing by dashed lines 47, is established between the two electrodes described above by providing an aqueous electrolyte in contact with the formation.
> (Bell, column 4, lines 66 to column 5, line 1).

Bell uses electrodes to provide direct current flow through the formation to electrochemically treat the formation. The electrodes are, in fact, kept below 500 °F using a coolant to prevent heating at or near the electrodes. Thus, Bell does not appear to teach or suggest resistive heating of the heater. With respect to Bell, the Examiner is using hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate Appellant's claimed invention without some teaching, suggestion, motivation, or objective reason to combine the teachings of the disclosures.

The Claims Are Patentable Over Eastlund In View Of Van Egmond And/Or Bell And/Or Rose

As noted above, the Examiner stated in the Final Office Action that: "Bell which shows a DC supply rather than the AC supply does not show a contrary teaching over Eastlund". In the Response to Office Action submitted May 5, 2008, Appellant submitted that Bell teaches away from the **invention of Rose** (not the invention of Eastlund) due to the use of DC supply rather than AC supply. Appellant noted that the invention of Rose requires the use of AC for the invention to operate correctly. Appellant further stated that Bell describes using direct current (DC) advantageously over using alternating current (AC) (see, for example, column 7, lines 6-41). Thus, Bell teaches away from the invention of Rose.

In the Final Office Action, the Examiner states that:

> With respect to Rose, the applicant argues Rose does not show or teach transferring heat to a hydrocarbon containing layer. It is noted, however, that Rose is applied to teach a known electrical heating element having the ferromagnetic sections and its advantageous use in the heating cable shown in Eastlund (Figures 7-10). The applicant argues that Eastlund teaches away from Rose since Eastlund shows providing a maximum current flow along the inner wall with little current flow over the outer wall of the tubing while Rose would teach providing significant current flow in the outer wall of the tubing. It is noted that Eastlund shows different heating elements and the applicant's argument relates to the tubing and sucker rod heating element whereas the Rose reference is applied to supplement that of the coaxial heater as shown on Figures 7-10.
>
> ("Response to Arguments" (Section 6), page 8).

Appellant notes that in the Final Office Action and in previous Office Actions it was unclear to Appellant as to which portions of Eastlund the Examiner used for the rejections as no specific reference was made to any section or figures of Eastlund.

Appellant submits that there appears to be no motivation to combine the teachings of Rose with Eastlund. Rose only refers to heating fluids inside of the device and Rose does not even mention wells or hydrocarbon containing formations. Specifically, Rose states: "It should be noted that the insulating layer 29 of Fig. 3 has been eliminated to provide a gap between return conductor 27 and ferromagnetic layer 31. This gap insulates such members from one another and may be employed to heat fluids; air, gas, water, or other liquid, for a variety of purposes. Any one of the insulating layers may be removed to accept fluid and in fact, three different fluids may be heated simultaneously to three different temperatures." (Rose, page 17, lines 18-26). Thus, Rose does not appear to teach or suggest transferring heat to a hydrocarbon containing layer of the formation and using that heat to mobilize hydrocarbons in the hydrocarbon containing layer, as described in the combinations of features of claims 1691, 1711, and 1731.

The Examiner applies the disclosure of Rose to the disclosure of Eastlund that relates to the coaxial heater depicted in Figures 7-10. As noted by the Examiner in the Final Office Action, Eastlund "does not explicitly disclose an overburden formation and that the steel outer conductor

is ferromagnetic." (Section 2, page 2). Without an explicit disclosure of the use of ferromagnetic material in the coaxial heater of Eastlund, Appellant submits that there is no teaching, suggestion, or motivation to use a ferromagnetic material as described in Rose in the coaxial heater of Eastlund depicted in Figures 7-10. Without some teaching, suggestion, motivation, or objective reason to combine the teachings of Rose with the teachings of Eastlund, the Examiner is using hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate Appellant's claimed invention.

In addition, Eastlund states: "An object of this invention is to electrically heat the tubing of a petroleum well by passing current through the tubing to **prevent formation of solids** such as paraffins." (Eastlund, column 1, lines 47-50) (Emphasis added). This object of the invention appears to encompass all embodiments described in Eastlund, including Figures 7-10. Modifying the Eastlund device to operate at or near the Curie temperatures described by Rose would appear to render the Eastlund device unsatisfactory for its intended purpose of preventing formation of solids. In fact, operating the Eastlund device at or near the Curie temperatures (which are generally much higher than the temperatures contemplated by Eastlund) may **increase the formation of solids** by increasing the cracking of hydrocarbons (petroleum) inside the tubing, thus leading to coke (solid carbon) formation in the tubing. Thus, Eastlund appears to teach away from operating at or near the Curie temperatures as described by Rose.

Much of the disclosure of Eastlund also appears to teach away from operating at higher temperatures (for example, at or near the Curie temperatures described by Rose). Eastlund states: "It is believed that the maximum current flows primarily along the **inner** wall and decreases radially outward from the inner wall of the tubing with very little current flowing along the outer wall of the tubing. For this reason, shorting between the tubing and casing does not significantly affect the heating of the tubing by the current flowing therethrough and of course heat transfer through the liquid medium from the sucker rod." (Eastlund, column 7, lines 23-31) (Emphasis added). Eastlund also states: "In a test utilizing the system of FIG. 6 the casing and tubing were in electrical contact and shorted at 575 feet and 2,050 feet. The wire extended down in the well to a depth of 800 feet where the wire was shorted to the tubing by a scratcher. Fifty feet of free wire was connected to a source of power delivering 2140 watts from a 120 volt source. Power was controlled by an S.C.R. power controller. After 12.5 hours temperature at 350 feet had increased

from 77° F. to 89° F. and at 750 feet had increased from 80° F. to 90° F. This test demonstrated that shorting between the tubing and casing does not substantially reduce the efficiency of the system of FIG. 6." (Eastlund, column 9, lines 21-33).

If, however, the Eastlund device were to operate at the Curie temperature, as taught by the Rose device, electrical current would flow through the entirety of the heater at the Curie temperature and significant current would flow along the **outer** wall of the tubing of the Eastlund device. Having significant electrical current flow on the tubing outer wall, along with shorting between the tubing and the casing, would significantly affect the heating of the tubing. Electrical current would flow between the tubing and casing due to the shorting if the heater were to operate at or near the Curie temperature. Thus, Eastlund teaches away from having electrical current flowing through the entire heater, as occurs at the Curie temperatures described by Rose. Thus, modifying certain embodiments of the Eastlund device to operate at the Curie temperatures described by Rose would appear to make the Eastlund device unsatisfactory for its intended purpose as disclosed by the above-quoted requirements for the Eastlund device.

For at least the reasons stated above, Appellant respectfully submits that claims 1691, 1711, and 1731 are allowable over the cited art.

Claims 1692 and 1712

Claims 1692 and 1712 describe combinations of features including, but not limited to, the features of: "at least one production well extending into the hydrocarbon containing layer and configured to produce at least some of the mobilized hydrocarbons from the hydrocarbon containing layer." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1693 and 1713

Claims 1693 and 1713 describe combinations of features including, but not limited to, the features of: "wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1694 and 1714

Claims 1694 and 1714 describe combinations of features including: "wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to pyrolyze at least some hydrocarbons in the layer." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711. In addition, Appellant notes that the lower temperatures set forth in Eastlund (e.g., 73 °F to 115 °F (22 °C to 47 °C) *see* Eastlund col. 4, lines 39-44) would not be sufficient to pyrolyze at least some hydrocarbons in the formation, and thus Eastlund teaches away.

Claims 1695 and 1715

Claims 1695 and 1715 describe combinations of features including: "wherein at least one of the ferromagnetic sections heats during use to a temperature of at least about 650 °C." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711. In addition, Appellant notes that the lower temperatures set forth in Eastlund (e.g., 73 °F to 115 °F (22 °C to 47 °C) *see* Eastlund col. 4, lines 39-44) would not be sufficient to heat to a temperature of at least about 650 °C, and thus Eastlund teaches away.

Claims 1696 and 1716

Claims 1696 and 1716 describe combinations of features including: "wherein the AC supply is configured to provide AC at a voltage below about 2500 volts." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1699 and 1719

Claims 1699 and 1719 describe combinations of features including: "wherein at least one of the ferromagnetic sections comprises iron, nickel, chromium, cobalt, tungsten, or a mixture thereof." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1700 and 1720

Claims 1700 and 1720 describe combinations of features including: "wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of the AC at the Curie temperature of such ferromagnetic sections." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1701 and 1721

Claims 1701 and 1721 describe combinations of features including: "wherein the heat output below the selected temperature is greater than about 400 watts per meter of electrical conductor." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711. In addition, Appellant notes that Eastlund teaches a heat output of 31 watts per ft or 102 watts per meter (*see* Eastlund col. 4, lines 39-44), and thus Eastlund teaches away.

Claims 1702 and 1722

Claims 1702 and 1722 describe combinations of features including: "wherein at least a portion of the electrical conductor is longer than about 10 m." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1703 and 1723

Claims 1703 and 1723 describe combinations of features including: "wherein one or more of the ferromagnetic sections are configured to sharply reduce the heat output at or near the selected temperature." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1704 and 1724

Claims 1704 and 1724 describe combinations of features including: "wherein the heat output from at least a portion of the ferromagnetic sections decreases at or near the selected temperature due to the Curie effect." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1705 and 1725

Claims 1705 and 1725 describe combinations of features including: "wherein the AC resistance of the electrical conductor increases with an increase in temperature up to the selected temperature, and wherein the AC resistance of the electrical conductor decreases with an increase in temperature above the selected temperature." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1706 and 1726

Claims 1706 and 1726 describe combinations of features including: "wherein the AC supply provides an electrical current of at least about 70 amps to the electrical conductor." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1707 and 1727

Claims 1707 and 1727 describe combinations of features including: "wherein at least one of the electrical conductors comprises a turndown ratio of at least about 2 to 1." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1708 and 1728

Claims 1708 and 1728 describe combinations of features including: "wherein the AC supply applies AC at about 180 Hz." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1709 and 1729

Claims 1709 and 1729 describe combinations of features including: "wherein the system withstands operating temperatures of about 250 °C or above." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claims 1710 and 1730

Claims 1710 and 1730 describe combinations of features including: "wherein the electrical conductor automatically provides the reduced amount of heat above or near the selected temperature." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Claim 1732

Claim 1732 describes a combination of features including: "producing at least some of the mobilized hydrocarbons from the layer through a production well extending into the hydrocarbon containing layer." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1733

Claim 1733 describes a combination of features including: "wherein the transferred heat pyrolyzes at least some hydrocarbons in the hydrocarbon containing layer." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731. In addition, Appellant notes that the lower temperatures set forth in Eastlund (e.g., 73 °F to 115 °F (22 °C to 47 °C) *see* Eastlund col. 4, lines 39-44) would not be sufficient to pyrolyze at least some hydrocarbons in the formation, and thus Eastlund teaches away.

Claim 1734

Claim 1734 describes a combination of features including: "producing at least some of the pyrolyzed hydrocarbons from the layer through a production well extending into the hydrocarbon containing layer." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731. In addition, Appellant notes that the lower temperatures set forth in Eastlund (e.g., 73 °F to 115 °F (22 °C to 47 °C) *see* Eastlund col. 4, lines 39-44) would not be sufficient to pyrolyze at least some hydrocarbons in the formation, and thus Eastlund teaches away.

Claim 1736

Claim 1736 describes a combination of features including: "wherein at least one of the ferromagnetic sections heats to a temperature of at least about 650 °C." Appellant respectfully

traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731. In addition, Appellant notes that the lower temperatures set forth in Eastlund (e.g., 73 °F to 115 °F (22 °C to 47 °C) *see* Eastlund col. 4, lines 39-44) would not be sufficient to heat to a temperature of at least about 650 °C and thus Eastlund teaches away.

Claim 1737

Claim 1737 describes a combination of features including: "providing the AC at a voltage below about 2500 volts." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1738

Claim 1738 describes a combination of features including: "providing the AC to at least one of the electrical conductors at or above the selected temperature." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1739

Claim 1739 describes a combination of features including: "providing the AC at a frequency of about 180 Hz." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1740

Claim 1740 describes a combination of features including: "providing an initial electrically resistive heat output when the electrical conductor providing the heat output is at least about 50 °C below the selected temperature, and automatically providing the reduced amount of heat above or near the selected temperature." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1741

Claim 1741 describes a combination of features including: "wherein an AC resistance of at least one of the ferromagnetic sections decreases above the selected temperature to provide the

reduced amount of heat." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1742

Claim 1742 describes a combination of features including: "wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of AC at the Curie temperature of the ferromagnetic material." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1743

Claim 1743 describes a combination of features including: "wherein the reduced amount of heat is less than about 400 watts per meter of length of electrical conductor." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731. In addition, Appellant notes that Eastlund teaches a heat output of 31 watts per ft or 102 watts per meter (*see* Eastlund col. 4, lines 39-44) and thus Eastlund teaches away.

Claim 1744

Claim 1744 describes a combination of features including: "controlling a skin depth in at least one of the ferromagnetic sections by controlling a frequency of the applied AC." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1745

Claim 1745 describes a combination of features including: "applying additional current to at least one of the ferromagnetic sections as the temperature of such ferromagnetic sections increases until the temperature is at or near the selected temperature." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1746

Claim 1746 describes a combination of features including: "controlling an amount of

heat provided by at least one of the ferromagnetic sections by controlling an amount of current applied to at least one of the electrical conductors." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claim 1747

Claim 1747 describes a combination of features including: "applying current of at least about 70 amps to at least one of the electrical conductors." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claim 1731.

Claims 1748, 1750, and 1752

Claims 1748, 1750, and 1752 describe combinations of features including: "wherein the heater well extends at least about 10 m into the hydrocarbon containing layer." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691, 1711, and 1731.

Claims 1749, 1751, and 1753

Claims 1749, 1751, and 1753 describe combinations of features including: "wherein the hydrocarbon containing layer comprises hydrocarbons configured to be treated and produced from the formation using an in situ conversion process." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691, 1711, and 1731.

Second Ground of Rejection

The Examiner rejected claims 1698 and 1718 under 35 U.S.C. 103(a) as being unpatentable over Eastlund in view of Van Egmond, Bell, and Rose as applied to claims 1691-1697, 1699-1717 and 1719-1753 above, and further in view of Canadian Patent No. 2,151,521 to Bridges et al.. Appellant respectfully traverses these rejections in light of the following remarks. Different groups of claims are addressed under their respective subheadings.

Claims 1698 and 1718

Claims 1698 and 1718 describe combinations of features including: "wherein the system comprises three or more electrical conductors, and wherein at least three of the electrical conductors are coupled in a three-phase electrical configuration." Appellant respectfully traverses this rejection for at least the reasons given above in the discussion of the rejection of independent claims 1691 and 1711.

Third Ground of Rejection

The Examiner provisionally rejected claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753 under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753 of copending U.S. Pat. Appl. No. 10/693,700 or claims 1691-1759 of copending U.S. Pat. Appl. No. 10/693,840. Upon the present application being in condition for allowance but for the double patenting rejections, Appellant will provide a terminal disclaimer.

VIII. CONCLUSION

For the foregoing reasons, it is submitted that the Examiner's rejections of claims 1691-1696, 1698-1716, 1718-1734, and 1736-1753 were erroneous, and reversal of Examiner's decision is respectfully requested.

Appellant hereby requests a one-month extension of time for filing this brief. An authorization for the appeal brief fee and the one-month extension of time will be made upon electronic submission of this document. If any further extension of time is necessary, Appellant hereby requests the appropriate extension of time. If any fees are omitted or if fees have been overpaid, please appropriately charge or credit those fees to Meyertons, Hood, Kivlin, Kowert & Goetzel P.C., Deposit Account No. 50-1505/5659-20900/EBM.

Respectfully submitted,

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IX. CLAIMS APPENDIX

The claims on appeal are as follows.

1691. A system configured to heat a hydrocarbon containing formation, comprising:

a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation;

an AC supply configured to provide AC at a voltage above about 200 volts; and

one or more electrical conductors located in the heater well and extending from the surface into the hydrocarbon containing layer, the electrical conductors being electrically coupled to the AC supply;

at least one electrical conductor comprising one or more ferromagnetic sections, and being configured to provide an electrically resistive heat output during application of AC to the electrical conductor such that heat transfers from the electrical conductor to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer;

wherein one or more of the ferromagnetic sections provides a reduced amount of heat above or near a selected temperature during use, wherein the selected temperature is at or about the Curie temperature of the ferromagnetic section.

1692. The system of claim 1691, further comprising at least one production well extending into the hydrocarbon containing layer and configured to produce at least some of the mobilized hydrocarbons from the hydrocarbon containing layer.

1693. The system of claim 1691, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

1694. The system of claim 1691, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to pyrolyze at least some hydrocarbons in the layer.

1695. The system of claim 1691, wherein at least one of the ferromagnetic sections heats during use to a temperature of at least about 650 °C.

1696. The system of claim 1691, wherein the AC supply is configured to provide AC at a voltage below about 2500 volts.

1698. The system of claim 1691, wherein the system comprises three or more electrical conductors, and wherein at least three of the electrical conductors are coupled in a three-phase electrical configuration.

1699. The system of claim 1691, wherein at least one of the ferromagnetic sections comprises iron, nickel, chromium, cobalt, tungsten, or a mixture thereof.

1700. The system of claim 1691, wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of the AC at the Curie temperature of such ferromagnetic sections.

1701. The system of claim 1691, wherein the heat output below the selected temperature is greater than about 400 watts per meter of electrical conductor.

1702. The system of claim 1691, wherein at least a portion of the electrical conductor is longer than about 10 m.

1703. The system of claim 1691, wherein one or more of the ferromagnetic sections are configured to sharply reduce the heat output at or near the selected temperature.

1704. The system of claim 1691, wherein the heat output from at least a portion of the ferromagnetic sections decreases at or near the selected temperature due to the Curie effect.

1705. The system of claim 1691, wherein the AC resistance of the electrical conductor increases with an increase in temperature up to the selected temperature, and wherein the AC resistance of the electrical conductor decreases with an increase in temperature above the selected temperature.

1706. The system of claim 1691, wherein the AC supply provides an electrical current of at least about 70 amps to the electrical conductor.

1707. The system of claim 1691, wherein at least one of the electrical conductors comprises a turndown ratio of at least about 2 to 1.

1708. The system of claim 1691, wherein the AC supply applies AC at about 180 Hz.

1709. The system of claim 1691, wherein the system withstands operating temperatures of about 250 °C or above.

1710. The system of claim 1691, wherein the electrical conductor automatically provides the reduced amount of heat above or near the selected temperature.

1711. A system configured to heat a hydrocarbon containing formation, comprising:

a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation;

an AC supply configured to provide AC at a voltage above about 200 volts; and

one or more electrical conductors located in the heater well and extending from the surface into the hydrocarbon containing layer, the electrical conductors being electrically coupled to the AC supply;

at least one electrical conductor comprising one or more ferromagnetic sections, and being configured to provide an electrically resistive heat output during application of AC to the electrical conductor such that heat transfers from the electrical conductor to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer;

wherein one or more of the ferromagnetic sections provides a reduced amount of heat above or near a selected temperature that is about 20% or less of the heat output at about 50 °C below the selected temperature during use, wherein the selected temperature is at or about the Curie temperature of the ferromagnetic section.

1712. The system of claim 1711, further comprising at least one production well extending into the hydrocarbon containing layer and configured to produce at least some of the mobilized hydrocarbons from the hydrocarbon containing layer.

1713. The system of claim 1711, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

1714. The system of claim 1711, wherein at least one electrical conductor transfers heat during use to hydrocarbons in the hydrocarbon containing layer to pyrolyze at least some hydrocarbons in the layer.

1715. The system of claim 1711, wherein at least one of the ferromagnetic sections heats during use to a temperature of at least about 650 °C.

1716. The system of claim 1711, wherein the AC supply is configured to provide AC at a voltage below about 2500 volts.

1718. The system of claim 1711, wherein the system comprises three or more electrical conductors, and wherein at least three of the electrical conductors are coupled in a three-phase electrical configuration.

1719. The system of claim 1711, wherein at least one of the ferromagnetic sections comprises iron, nickel, chromium, cobalt, tungsten, or a mixture thereof.

1720. The system of claim 1711, wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of the AC at the Curie temperature of such ferromagnetic sections.

1721. The system of claim 1711, wherein the heat output below the selected temperature is greater than about 400 watts per meter of electrical conductor.

1722. The system of claim 1711, wherein at least a portion of the electrical conductor is longer than about 10 m.

1723. The system of claim 1711, wherein one or more of the ferromagnetic sections are configured to sharply reduce the heat output at or near the selected temperature.

1724. The system of claim 1711, wherein the heat output from at least a portion of the ferromagnetic sections decreases at or near the selected temperature due to the Curie effect.

1725. The system of claim 1711, wherein the AC resistance of the electrical conductor increases with an increase in temperature up to the selected temperature, and wherein the AC resistance of the electrical conductor decreases with an increase in temperature above the selected temperature.

1726. The system of claim 1711, wherein the AC supply provides an electrical current of at least about 70 amps to the electrical conductor.

1727. The system of claim 1711, wherein at least one of the electrical conductors comprises a turndown ratio of at least about 2 to 1.

1728. The system of claim 1711, wherein the AC supply applies AC at about 180 Hz.

1729. The system of claim 1711, wherein the system withstands operating temperatures of about 250 °C or above.

1730. The system of claim 1711, wherein the electrical conductor automatically provides the reduced amount of heat above or near the selected temperature.

1731. A method of heating a hydrocarbon containing formation, comprising:

providing AC at a voltage above about 200 volts to one or more electrical conductors located in a heater well extending from a surface of the earth through an overburden of the formation and into a hydrocarbon containing layer in the formation, wherein providing the AC produces an electrically resistive heat output from the electrical conductors, at least one of the electrical conductors comprising one or more ferromagnetic sections; and

wherein one or more of the ferromagnetic sections are configured to provide a reduced amount of heat above or near a selected temperature during use, wherein the selected temperature is at or about the Curie temperature of the ferromagnetic section; and

allowing heat to transfer from the electrical conductors to hydrocarbons in the hydrocarbon containing layer to at least mobilize some hydrocarbons in the layer.

1732. The method of claim 1731, further comprising producing at least some of the mobilized hydrocarbons from the layer through a production well extending into the hydrocarbon containing layer.

1733. The method of claim 1731, wherein the transferred heat pyrolyzes at least some hydrocarbons in the hydrocarbon containing layer.

1734. The method of claim 1733, further comprising producing at least some of the pyrolyzed hydrocarbons from the layer through a production well extending into the hydrocarbon containing layer.

1736. The method of claim 1731, wherein at least one of the ferromagnetic sections heats to a temperature of at least about 650 °C.

1737. The method of claim 1731, further comprising providing the AC at a voltage below about 2500 volts.

1738. The method of claim 1731, further comprising providing the AC to at least one of the electrical conductors at or above the selected temperature.

1739. The method of claim 1731, further comprising providing the AC at a frequency of about 180 Hz.

1740. The method of claim 1731, further comprising providing an initial electrically resistive heat output when the electrical conductor providing the heat output is at least about 50 °C below the selected temperature, and automatically providing the reduced amount of heat above or near the selected temperature.

1741. The method of claim 1731, wherein an AC resistance of at least one of the ferromagnetic sections decreases above the selected temperature to provide the reduced amount of heat.

1742. The method of claim 1731, wherein at least one of the ferromagnetic sections has a thickness of at least about ¾ of a skin depth of AC at the Curie temperature of the ferromagnetic material.

1743. The method of claim 1731, wherein the reduced amount of heat is less than about 400 watts per meter of length of electrical conductor.

1744. The method of claim 1731, further comprising controlling a skin depth in at least one of the ferromagnetic sections by controlling a frequency of the applied AC.

1745. The method of claim 1731, further comprising applying additional current to at least one of the ferromagnetic sections as the temperature of such ferromagnetic sections increases until the temperature is at or near the selected temperature.

1746. The method of claim 1731, further comprising controlling an amount of heat provided by at least one of the ferromagnetic sections by controlling an amount of current applied to at least one of the electrical conductors.

1747. The method of claim 1731, further comprising applying current of at least about 70 amps to at least one of the electrical conductors.

1748. The system of claim 1691, wherein the heater well extends at least about 10 m into the hydrocarbon containing layer.

1749. The system of claim 1691, wherein the hydrocarbon containing layer comprises hydrocarbons configured to be treated and produced from the formation using an in situ conversion process.

1750. The system of claim 1711, wherein the heater well extends at least about 10 m into the hydrocarbon containing layer.

1751. The system of claim 1711, wherein the hydrocarbon containing layer comprises hydrocarbons configured to be treated and produced from the formation using an in situ conversion process.

1752. The method of claim 1731, wherein the heater well extends at least about 10 m into the hydrocarbon containing layer.

1753. The method of claim 1731, wherein the hydrocarbon containing layer comprises hydrocarbons configured to be treated and produced from the formation using an in situ conversion process.

X. EVIDENCE APPENDIX

None

XI. RELATED PROCEEDINGS APPENDIX

None